Wind and rain records for Storm Desmond

Description

Storm Desmond, the fourth named storm of the season, bought widespread heavy rain and storm force winds to areas of northern England and Scotland.

The rainfall experienced in many parts of the north west of the UK is thought to have been exceptional and early provisional rainfall statistics indicate many places have seen totals widely over 180 to 200 mm in the Lake District. It is thought very locally event totals may be in excess of 300 mm locally. The Met Office issued a Red 'take action' severe weather warning for rainfall yesterday, the first red warning since February 2014.

48 Hour UK Rainfall Total 0900 4th December – 0900 6th December

Site Name	Area	Rainfall Total mm
Shap	Cumbria	262.6
Keswick	Cumbria	178.4
Blencathra	Cumbria	174.8
Capel Curig	Gwynedd	170.6
Tyndrum	Perthshire	141
Eskdalemuir	Dumfriesshire	139.2
Bainbridge	North Yorkshire	136
Cluanie Inn	Ross & Cromarty	132.8

The rainfall caused some rivers to flood and homes had to be evacuated in areas of Cumbria and in Northumberland. The Environment Agency still has a number of flood warnings in place.

An Amber 'be prepared' warning for wind was in place for parts of SE Scotland and NE England as wind speeds were expected that could potentially cause disruption, structural damage and disrupt transport. Gusts of over 80 mph were experienced in more exposed locations, with the strongest recorded gust of 99 mph at Great Dun Fell, a high level site in Cumbria at 847m.

Max Gust Speeds 5 December 1800 – 6 December 0900

Site Name	Area	Max Gust mph
Capel Curig	Gwynedd	81
Needles Old Battery	Isle of Wight	78
High Bradfield	South Yorkshire	77
Redesdale Camp	Northumberland	73
Loftus	Cleveland	70
Aberdaron	Gwynedd	69
Charterhall	Berwickshire	68

Valley	Gwynedd	67

There are no weather warnings in place for the rest of today (Sunday), however the Environment Agency and the Scottish Environment Protection Agency (SEPA) still have a number of flood warnings in place as water courses are still reacting to yesterday's rainfall. A warning is in place for Monday and will be updated as required.

You can keep up to date with the latest forecast using our five day forecast pages, the latest weather warnings on our National Severe Weather Warnings pages and find out what to do in severe weather.

Date Created
December 2015

Did climate change have an impact on Storm Desmond?

Description

The exceptional rainfall in Cumbria over the past few days saw the fall of numerous records and has led many to ask whether it is linked to climate change. The records are based on digitised data going back to the 19th Century.

A gauge at Honister Pass recorded 341.4mm of rainfall in the 24-hours up to 1800 GMT on 5 December 2015, making for a new UK record for any 24-hour period. This beat the previous record of 316.4mm set in November 2009 at Seathwaite, also in Cumbria. A new 48-hour record (from 0900 to 0900 hrs) was also set, when 405mm was recorded at Thirlmere in Cumbria in just 38 hrs.

The weekend's record rainfall was associated with a persistent, south-westerly flow bringing a 'river of moisture' from as far away as the Caribbean and the Gulf of Mexico. Ocean temperatures in the West Atlantic are currently well above normal and may well have contributed to the very high levels of moisture in the air masses which unleashed rainfall on the Cumbrian fells.

Professor Dame Julia Slingo, Met Office Chief Scientist, says "It's too early to say definitively whether climate change has made a contribution to the exceptional rainfall. We anticipated a wet, stormy start to winter in our three-month outlooks, associated with the strong El Niño and other factors.

"However, just as with the stormy winter of two years ago, all the evidence from fundamental physics, and our understanding of our weather systems, suggests there may be a link between climate change and record-breaking winter rainfall. Last month, we published a paper showing that for the same weather pattern, an extended period of extreme UK winter rainfall is now seven times more likely than in a world without human emissions of greenhouse gases."

Date Created
December 2015

Climate change and weather caught in a media storm

Description

December so far has been characterised by intense media discussions about climate change and its relationship to weather.

Early in the month, the Met Office welcomed the BBC Trust report, which recognised there was a serious breach of their editorial guidelines and that the What's the Point of the.. Met Office programme, aired in August, had failed to make clear that the Met Office's underlying views on climate change science were supported by the majority of scientists.

Trustees considered audiences were not given sufficient information about prevailing scientific opinion to allow them to assess the position of the Met Office and the Met Office position on these criticisms was not adequately included in the programme.

In the wake of Storm Desmond, there have been further media comments about the relationship between climate change and weather.

On Monday, in a blog, we were very clear not to link the record-breaking rainfall with climate change. This is what Professor Dame Julia Slingo, Met Office Chief Scientist has said: "It's too early to say definitively whether climate change has made a contribution to the exceptional rainfall. We anticipated a wet, stormy start to winter in our three-month outlooks, associated with the strong El Niño and other factors.

"However, just as with the stormy winter of two years ago, all the evidence from fundamental physics, and our understanding of our weather systems, suggests there may be a link between climate change and record-breaking winter rainfall. Last month, we published a paper showing that for the same weather pattern, an extended period of extreme UK winter rainfall is now seven times more likely than in a world without human emissions of greenhouse gases."

So, we have been clear: it's not easy to link a single weather event to climate change, but last weekend's record rainfall aligns with the pattern highlighted by our scientists. The Met Office expects an increase in heavy rainfall associated with climate change and this is an active area of research. A recent paper by the Met Office's Mike Kendon highlights several key findings connected with rainfall records:

- Since 2000 there have been almost 10 times as many wet records as dry records.
- Remarkably, the period since 2010 accounts for more wet records than any other decade – even though this is only a five-year period. It also includes the winter of 2013/14: the wettest on record.

Guided by peer-reviewed science, the Met Office recognises the climate is changing, and with that comes an expectation that more records will be broken.

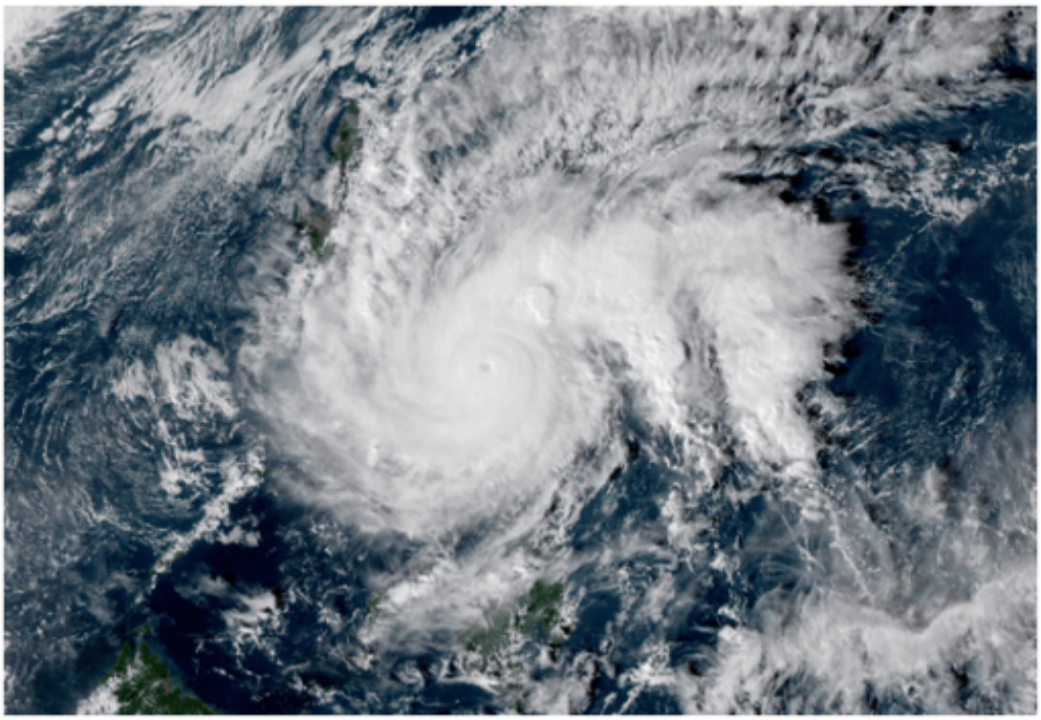
Date Created
December 2015

Typhoon Melor bringing stormy weather to the Philippines

Description

After an extremely active northern hemisphere tropical cyclone season in 2015, the last couple of weeks have been very quiet. This is not unusual as the season often tails off in November and December. However, there has been a sting in the tail in the form of Typhoon Melor. Late last week a disturbance in the western North Pacific started to develop and during the weekend quickly intensified into Typhoon Melor. On Monday morning at landfall, winds averaged over 1-minute peaked near 130 mph which makes Melor equivalent to a category 4 hurricane on the Saffir-Simpson Hurricane Wind Scale. Remarkably that makes Typhoon Melor the 27th tropical cyclone in the northern hemisphere to reach category 4 or 5 this year – a full nine more than the previous record set in 2004.

Melor has already tracked along the north coast of the Philippine island of Samar and has now made landfall over the south-east of the island of Luzon. Population centres such as Sorsogon City and Legazpi City are likely to experience very strong winds and heavy rainfall. Some areas of the central Philippines could see as much as 500-1000 mm of rain fall in the next couple of days which could bring floods and mudslides. Melor is expected to continue westwards towards Mindoro Island before moving into the South China Sea as a weakening storm.



Typhoon Melor at 0710 UTC on 14 December 2015
Image from the Himawari satellite

Although the main season for typhoons in the Philippines is from June to November, the country has been hit by several storms in December in recent years. In 2012 Typhoon Bopha struck the island of

Mindanao with winds near 165 mph causing much damage and numerous fatalities. A year earlier Tropical Storm Washi struck a similar location. Although winds were not exceptional, huge amounts of rain caused flooding and mudslides, again resulting in many casualties.

Official warnings for the latest tropical cyclones in the western North Pacific are produced by the Japan Meteorological Agency. The Met Office routinely supplies predictions of cyclone tracks from its global forecast model to regional meteorological centres worldwide, which are used along with guidance from other models in the production of forecasts and guidance. We also provide updates on current tropical storms via @metofficestorms on Twitter.

Date Created
December 2015

The science questions following a global deal on climate

Description

There has been a huge amount of worldwide media coverage following the weekend's announcement of a globally agreed deal to try to limit global warming to 2 °C or less. Here Professor Stephen Belcher, the Director of the Met Office's Hadley Centre for Climate Science and Services, discusses some of the scientific questions raised by the agreement.

At the heart of the Paris agreement is the aim to hold "the increase in the global average temperature to well below 2 °C above pre-industrial levels"*. Why 2 °C? Because global governments have previously agreed this is an achievable target which could reduce some of the most dangerous impacts of climate change – such as melting of ice in places like the Greenland which would cause large scale sea level rise.

The agreement went even further, however, by saying efforts should be pursued to "limit the temperature increase to 1.5 °C". This is a more ambitious target, especially given news from the Met Office in November that the world has reached the 1 °C above pre-industrial marker for the first time this year.

It raises some interesting questions for scientists as to how we can achieve this: how much do we need to cut global greenhouse gas emissions? How quickly do we need to make those cuts? What else might we need to do to be able to keep warming to 1.5 °C – for example, would we need to develop technologies that actually remove CO2 from the atmosphere? If temperatures overshot 1.5 °C and then reduced to 1.5 °C, would sea level also overshoot and then reduce?

To answer these questions more precisely will require scientists to get an even more detailed understanding of how sensitive our climate is to CO2 and other greenhouse gases.

Key to this will be improving understanding of what we call 'Earth system feedbacks'. These are natural feedback processes which could either increase or decrease the amount of warming we might expect in response to a given amount of greenhouse gases. For example, we know that there are stores of greenhouse gases 'locked away' under frozen ground (permafrost) in some parts of the world, such as northern Russia. If that permafrost melts due to climate change, the gases would be released – which could further increase warming.

Scientists around the world are already working on providing answers to these questions by developing a new breed of 'Earth System Models' (essentially complex simulations of our planet run on powerful supercomputers), which take more of these feedback processes into account, and so will help inform planning of emissions to achieve the warming targets agreed in Paris.

Whether we limit warming to 2 °C or 1.5 °C, it's clear we can expect some further change to our global climate over the coming decades. Research shows us that this will lead to some impacts and it's vital that we understand in more detail what this means at a regional and local level.

For example, research tells us that some parts of the world can expect more extreme weather – including heat waves and increases in extreme rainfall. For those planning everything from future homes, to flood defences, to vital infrastructure, the detail on what to expect is essential.

Again, these are questions which science is already working to answer by harnessing new research and ever more powerful supercomputing technology. At the Met Office, we've published papers showing that we can expect more intense summer downpours for the UK in future – which raises the risk of flash flooding. We've also shown how the chances of summer heatwaves in Europe have dramatically increased.

There's still much more work to do in this area and it will be vital that the information generated by this research is presented in a way that allows everyone to make informed decisions about how we can become more resilient to our climate – whatever changes we can expect.

*There's a lot of scientific debate about exactly what 'pre-industrial levels' means and how you would measure that, but here we use the average of temperatures during the period 1850-1899 as our representation.

Date Created
December 2015

Saharan dust

Description

During Wednesday night the mild southerly airflow affecting the UK spread a thin ribbon of dust, originally lifted from the Sahara, northwards across parts of England and Wales. The dust has been detected just above the surface over many parts of the south of the UK by monitoring stations.

How long will it last?

The moderate pollution levels are only expected to be short-lived. A cold front moving eastwards across the UK on Thursday will result in the wind swinging round to a ‘cleaner’ south-westerly and therefore low air pollution levels across the whole country on Friday. Southerly winds on Saturday will increase the likelihood of further patches of Saharan dust being spread across the UK with a risk once again of some moderate air pollution levels across parts of England and Wales. Sunday will then see a return to low air pollution levels across the country. The rain may lead to some deposits of dust being left on surfaces as it washes the dust from the atmosphere.

What is Saharan dust?
Saharan dust is lifted by strong winds and can reach very high altitudes; from there it can be transported worldwide by winds, covering distances of thousands of kilometres. The dust gets caught in rain droplets in clouds, falling to the ground in rain. When the water evaporates, a thin layer of dust is left on surfaces, like cars. It can also lead to vivid sunsets.

Will this lead to blood rain?
No. We rarely, if ever, see blood rain in the UK. This is because to get blood rain, when rain actually appears red, you need red dust or particles in high concentrations in the air. Even worldwide, documented cases worldwide are quite rare.

Dust and air quality
Saharan dust is a contributing factor to air quality along with pollution levels and weather conditions.

The combination of southerly winds and lifted dust is forecast to result in locally moderate pollution levels over parts of England and Wales during Thursday, but with levels falling rapidly as winds turn more westerly.

Further information including health advice on the different air pollution bands can be found on the Defra UK-air website.

Date Created
December 2015

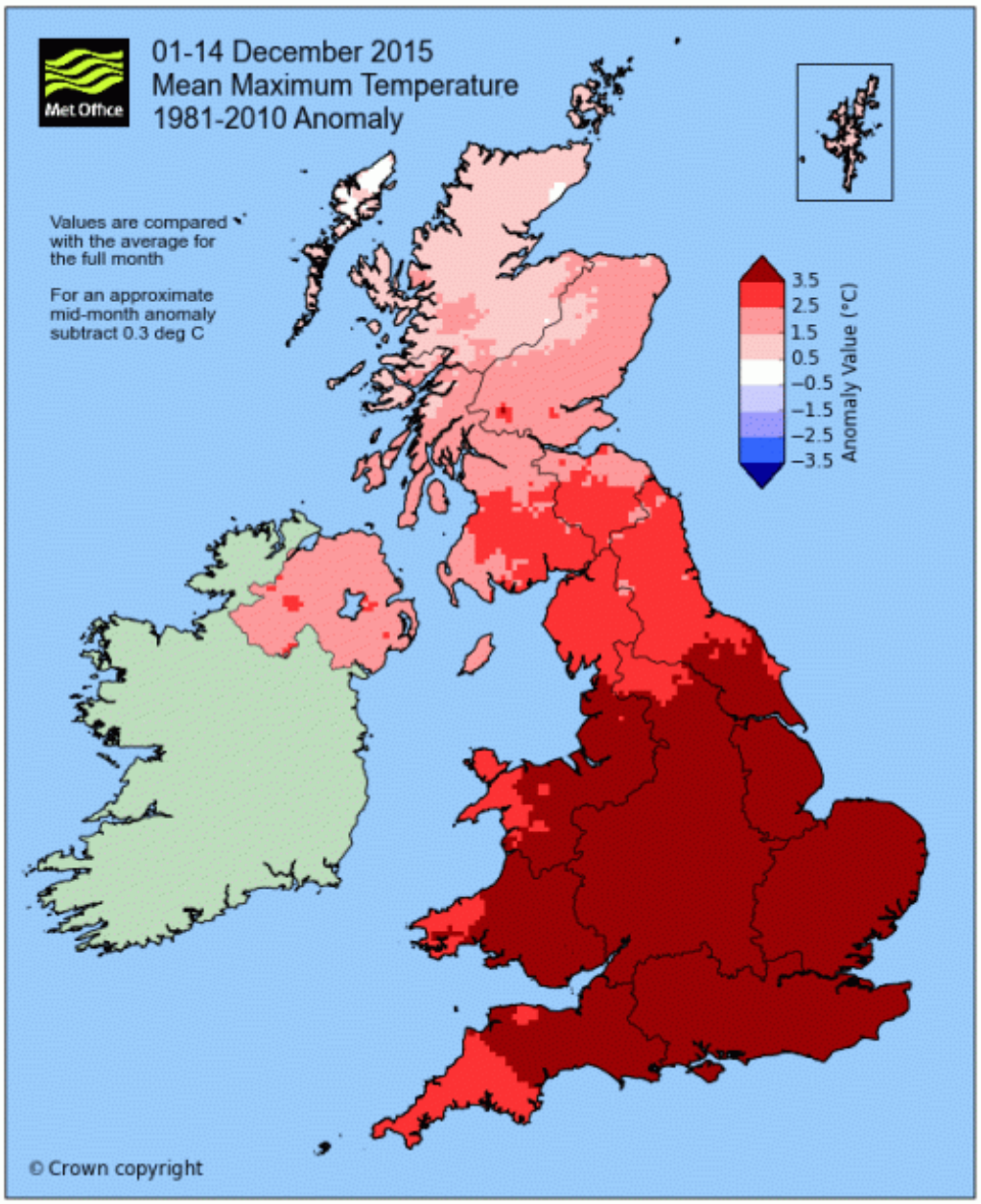
Mild start to December

Description

Looking at figures dating back to 1960 this has been the mildest start to December for Wales (8.7C), south west England (9.8C) and south east England (10C), and the 4th warmest for the UK as a whole (7.1C), with 1979, 2000 and 2006 being marginally milder.

Early provisional figures* (1-14 December) show the first half of December has been very mild across England and Wales with the maximum daily temperatures 3.2C above average for the UK as a whole.

However there has been a sharp north-south contrast at times with much colder air over Scotland and some frosts. Elsewhere the humid south-westerly airflow means the weather has remained similar to last month: cloudy with very few clear nights, mild nights and very little sunshine for most areas.



Mean Temperature 1 -14 December 2015

The main talking point so far this month has been Storm Desmond, bringing record-breaking rainfall totals over the Lake District and a lot of rain over many northern areas.

Around 200% of the whole month's normal rainfall has already fallen in a few places in the Pennines and the Lake District, it has also been wet in Snowdonia and parts of southern & central Scotland. There has been near-normal rainfall across many other areas, and actually below average, for this point in the month, in parts of southern England.

EARLY	**mean temperature**	**sunshine duration**	**precipitation**

1-14 Dec 2015	Act deg C	Anom deg C	Act Hours	Anom %	Act mm	Anom %
Regions						
UK	7.1	3.2	13.4	33	100.2	83
England	8.6	4.3	15.7	33	56.7	65
Wales	8.7	4.2	11.0	26	140.9	85
Scotland	4.2	1.4	10.4	34	161.6	99
N Ireland	6.1	1.6	13.1	35	99.0	87

Despite the mild start to winter following on from a mild autumn, it looks like 2015 will be an average year as far as weather is concerned.

This year's damp and cool spring and summer mean that despite the current mild spell, the rainfall, temperature and sunshine statistics for the year as a whole are all hovering around average, with just 17 days left until the end of the year.

Indications are that the unsettled weather will continue through Christmas and into the new year. Showers or longer spells of rain are expected across all parts, with the heaviest and most persistent rain in the north and west, and the best of the drier conditions across south-east England.

We can expect gales at times, again especially in the north and west. Temperatures will be closer to average than of late, but still generally above, with any snowfall restricted to the high ground of Scotland and northern England.

Please note that these provisional figures, especially for rainfall and sunshine, are subject to revision. Anomalies are expressed relative to the 1981-2010 averaging period.

*Data from the Met Office's UK digitised records dating back to 1910.

Date Created
December 2015

What’s ‘in store’ this Christmas?

Description

With Christmas just a few days away, it looks like the current mild weather is affecting our shopping habits during one of the most important shopping periods of the year.

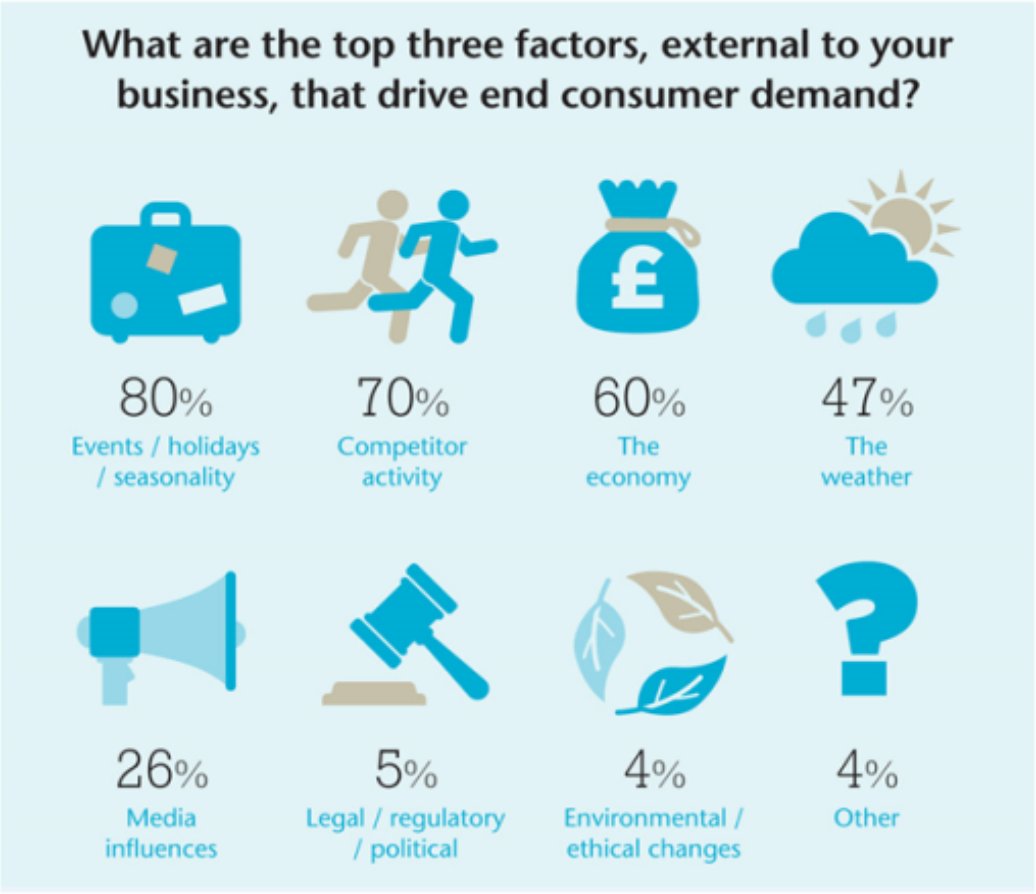
Christmas is a key trading period for suppliers and retailers, and the challenge is to take advantage of the seasonal uplift by making sure the goods we want are available on the shelves.

Recent press coverage has reported that Christmas shoppers are benefitting from the deepest high street discounts since 2008 after mild weather and a disappointing Black Friday left shops with stock to clear. Good news for the savvy shopper looking for a bargain, not so great for retailers who need to respond to these challenging conditions.

While we might normally expect sales of hats and scarves, sledges and de-icers to be at a peak in December, the reality this year is that they are unlikely to be top of anyone’s shopping list. In fact, the statistics halfway through this month showed that for Wales, southwest England and southeast England it has been the mildest start to December using data back to 1960. Provisional figures mid month show that the UK average maximum daily temperature is 3.2C above what would normally be expected at this point in December. Daily maximum temperatures in the mid-teens Celsius have been recorded, when values would normally be hovering around 6-7C.

Fashion stores have been particularly affected with lower demand for coats and knitwear, while a mild autumn and start to the winter has also impacted food retailers and sales of seasonal soups, winter vegetables and hot drinks.

Predicting demand accurately is a significant challenge for the retail industry. We recently carried out some research among executives and managers in retailers and suppliers and the findings highlighted how much of a challenge demand planning is and what a difference getting it right can make.



Results from ‘Understanding the role of weather in the supply chain’

Suppliers confirmed that improving demand planning accuracy is their number one priority and retailers highlighted better on-shelf availability as a goal. Across both groups, the top factor external to their business that drives consumer demand is seasonal holidays and events.

So Christmas puts extra pressure on retailers and suppliers at a time when weather (the fourth external factor they highlighted as affecting consumer demand) can make things even tougher. With the weather forecast for the next few days bringing more mild, wet and windy conditions, it doesn’t seem likely that we’ll be buying our winter woollies just yet. You can find out more about how we help retailers and suppliers with tailored weather forecast services here.

Check out our forecast pages to see what weather you can expect in the lead up to Christmas, to see if you’ll need to wear that Christmas jumper and whether you’ll see any snow on the big day.

Date Created
December 2015

December on track to be the mildest on record

Description

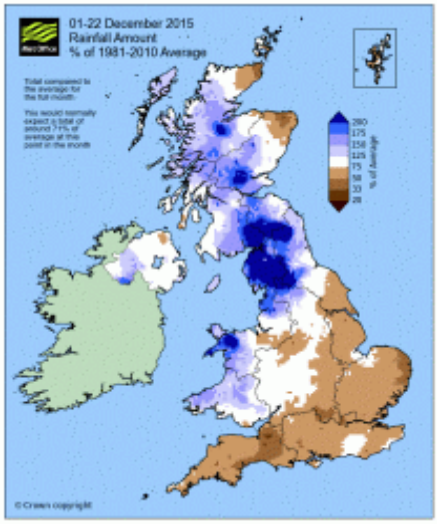
Mowing the lawn has been the reality for some so far this December, with unseasonably high temperatures. It looks as though the UK is on track to break the record for the warmest December since records began in 1910 and some areas have also seen their wettest.

The latest temperatures for December (1st to 22nd) reveal that the month so far has been far warmer than normal. Early provisional figures* reveal that the mean temperature for December in the UK has so far has been 8.1C, which is 4.2C above the long-term average for the month and well above the previous record of 6.9C set in 1934.

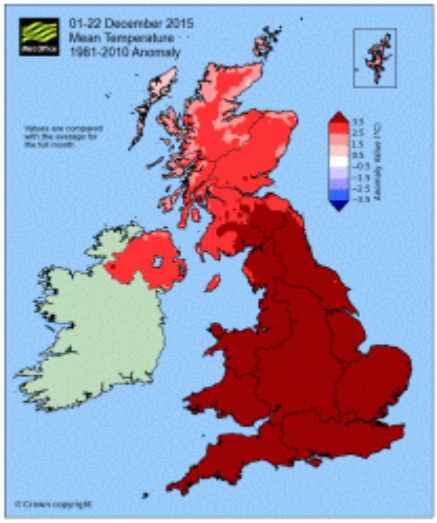
The December figure for England has so far been 9.5C, that's 5.1C above the same long-term average and 2C above the record of 7.5C set in 1934, and the other UK nations have been similarly warm:

- the mean temperature of 9.3C in Wales, higher than the previous post-1910 record of 7.5C set in 1934, and 4.8C above average
- the mean temperature of 5.6°C in Scotland is 2.8C above average, but is so far slightly lower than the previous December record of 5.8C set in 1988
- the mean temperature of 7.5°C in Northern Ireland is 3C higher than average, and marginally higher than the 1988 December record

Tim Legg of the Met Office National Climate Information Centre said: "With no sign of any significantly cold weather to come in the remaining 9 days of the month, we're on track to break the warmest December record which was set back in 1934."



Rainfall 1 – 22 Dec 2015



MeanTemperature Dec 1 – 22, 2015

Rainfall and sunshine figures so far confirm December has been dull and wet across most of the UK, with sunshine well down on the long-term average while precipitation (which of course has fallen mainly as rain) has been well above. Some places have seen record breaking rainfall:

- Cumberland 310.9mm rainfall 1 – 22nd Dec (previous record 248.2mm 2006),
- Westmorland 474.4mm 1 – 22nd Dec (previous record 365.1mm 2006)
- Dumfriesshire 314mm rainfall 1 – 22nd Dec (previous record 307.5mm 2013)
- Carnarvonshire 441.3mm rainfall 1 – 22nd Dec (previous record 376.6mm 1965)
- Roxburghshire 237.8mm rainfall 1 – 22nd Dec (previous record 219.7mm 2013)

EARLY	mean temperature		sunshine duration		precipitation	
1-22 Dec 2015	**Act**	**Anom**	**Act**	**Anom**	**Act**	**Anom**
	Deg C	**Deg C**	**hours**	**%**	**mm**	**%**
UK	8.1	4.2	17.7	43	148.0	123
England	9.5	5.1	19.8	42	86.5	99
Wales	9.3	4.8	16.3	39	237.1	143
Scotland	5.6	2.8	14.1	46	229.1	140
N Ireland	7.5	3.0	20.7	56	130.4	114

You can find out what the rest of the year has been like on our climate pages.

*Data from the Met Office's UK digitised records dating back to 1910.

Please note that these provisional figures, especially for rainfall and sunshine, are subject to revision. Anomalies are expressed relative to the 1981-2010 averaging period.

Date Created
December 2015

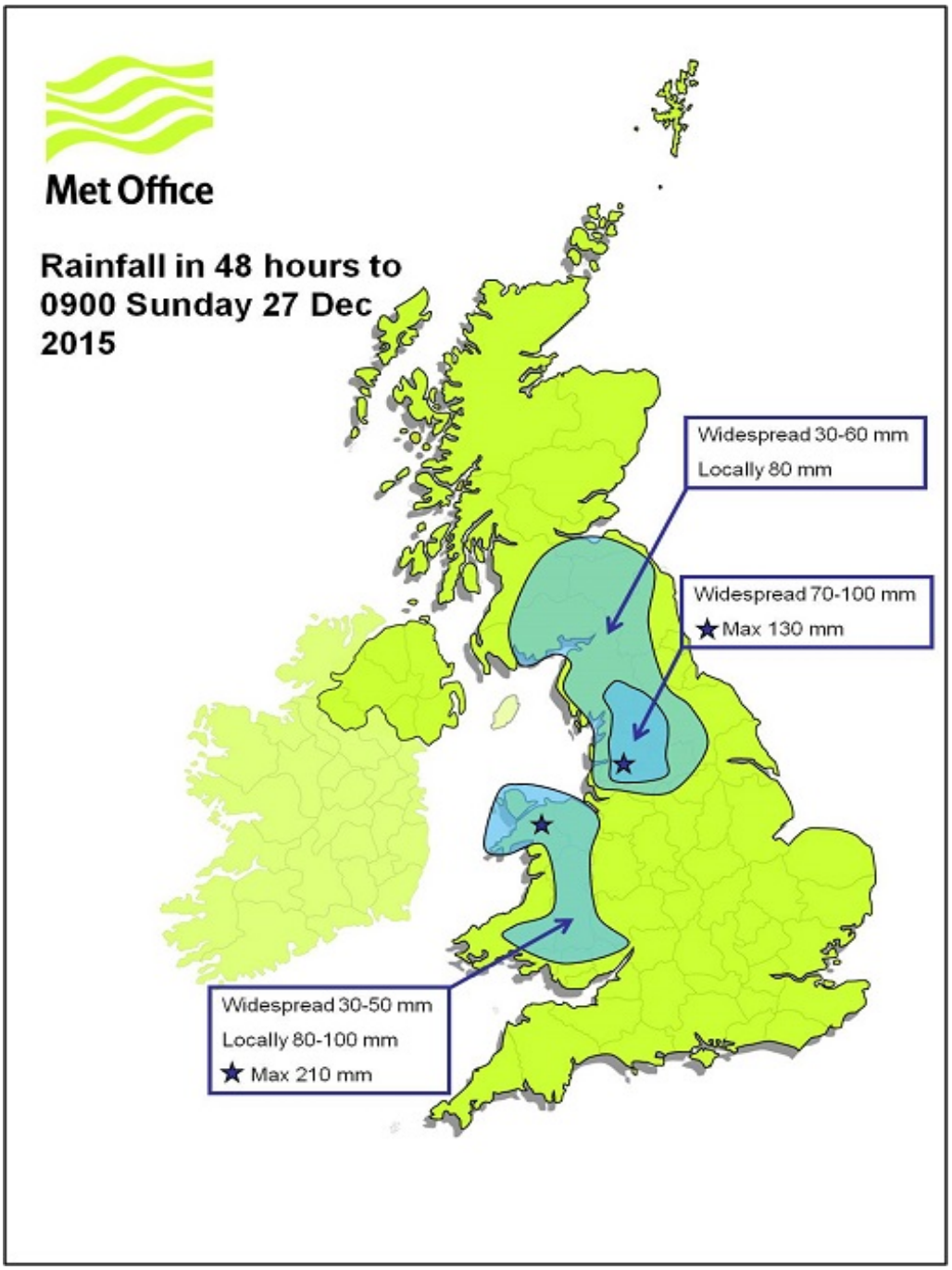
Record breaking December rainfall

Description

This is has already been a record breaking month for rainfall in some parts of the UK, with exceptional amounts of rain falling onto already saturated ground.

The very wet Boxing Day in parts of north Wales and northwest England was well forecast five days in advance with Amber, be prepared, warnings in force from as early as last Wednesday.

In the event the highest rainfall amounts were around 100mm with peaks of 130mm in Lancashire and in excess of 200mm in Snowdonia and caused high impacts across parts of north Wales and northern England.



Map showing two day rainfall totals for Christmas Day and Boxing Day

Here is a selection of the highest two day rainfall totals from Met Office observing sites for Christmas Day and Boxing Day:

48hr UK RAINFALL TOTALS 9am 25 DEC – 9am 27 DEC 2015

SITE	AREA	RAINFALL TOTAL (MM)
CAPEL CURIG	GWYNEDD	210.6
STONYHURST	LANCASHIRE	100

PATELEY BRIDGE, RAVENS NEST	NORTH YORKSHIRE	97
BINGLEY	WEST YORKSHIRE	93.6
BAINBRIDGE	NORTH YORKSHIRE	89.8
BALA	GWYNEDD	89.4
SHAP	CUMBRIA	86.4
SPADEADAM	CUMBRIA	79.4
PRESTON, MOOR PARK	LANCASHIRE	73.2
MYERSCOUGH	LANCASHIRE	72.4
BRADFORD	WEST YORKSHIRE	69.4
ROCHDALE	GREATER MANCHESTER	68.2
MORECAMBE	LANCASHIRE	65.8
MONA	ISLE OF ANGLESEY	63.6
KIELDER CASTLE	NORTHUMBERLAND	61.2
DISHFORTH AIRFIELD	NORTH YORKSHIRE	60.8

This wet spell has added to the heavy rainfall through the rest of the month to make December 2015 already the wettest on record in parts of the UK.

Here is a small selection of new December records from Met Office observing stations around the UK 9am 1 – 9am 28 December 2015:

Site	Total (mm)	81-10 avg (mm)	Previous record
Shap (Cumbria)	773.2	215.6	504.4mm in 2006
Keswick (Cumbria)	517.6	173	376.4mm in 2013
Warcop Range (Cumbria)	281.6	94.1	218.4mm in 2006
Stonyhurst (Lancashire)	331.4	141.6	319.3mm in 1951
Morecambe (Lancashire)	281.4	109.2	272mm in 1909
Bainbridge (North Yorkshire)	496.2	156.5	327.2mm in 2006
Bingley (West Yorkshire)	241.4	114.3	247.2mm in 2006
Eskdalemuir (Dumfries and Galloway)	500	184.9	390.4mm in 2014
Glasgow Bishopton	311.4	145.6	294.8mm in 2006
Capel Curig (Conwy)	1012.2	308.9	612.8mm in 2006

This very unsettled and occasionally stormy spell was well signalled in our recent three month outlooks and is not unusual for this time of year, indeed this is when climatologically we would expect to have most of our storms.

Throughout this unsettled spell Met Office meteorologists and advisors are working round the clock with our partners to keep everyone up to date with the latest forecast information so they can plan and prepare for the expected weather.

Date Created
December 2015

What’s been happening to our weather?

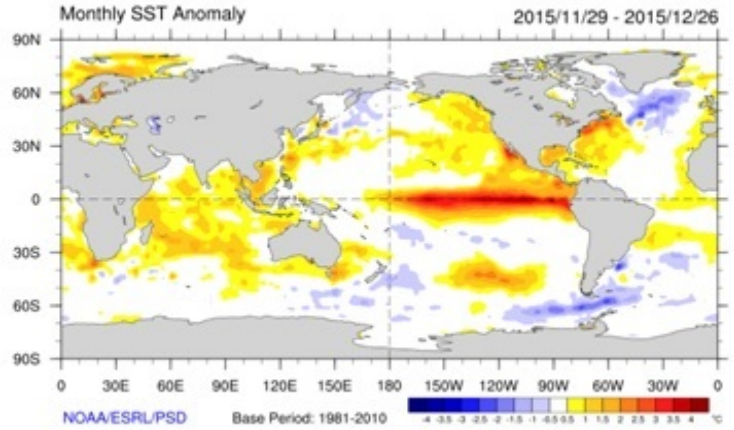
Description

December 2015 will go down in meteorological history as one of the wettest – and warmest – on record. It will also be remembered for the devastating floods in Cumbria, Lancashire, Yorkshire and Scotland. The extensive flooding of homes and businesses, loss of electrical power, major damage to roads and bridges, and disruption to the rail network have caused great misery and incurred huge losses.

In this blog our Chief Scientist, Professor Dame Julia Slingo, discusses what factors may have influenced the record breaking weather we have seen in recent weeks.

As with all high-impact weather, the meteorological set-up was critical in defining the severity of these events. Throughout the month, the winds have come from the south or southwest, bringing both extreme warmth but also very high levels of moisture.

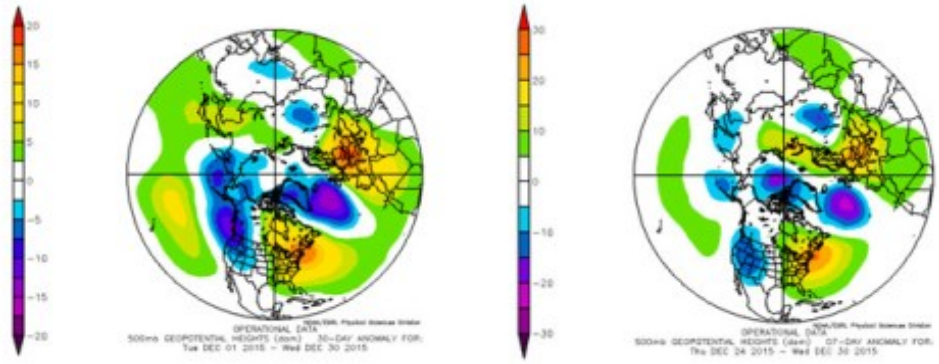
There has been a lot of debate whether this has been associated with El Nino – an intermittent warming of the equatorial Pacific Ocean which has been very strong this year – or whether this is a sign of a changing climate. The links to El Nino are certainly very clear in the set up of large waves (troughs and ridges) in the atmospheric circulation, which we expect to see in these events.



Latest monthly anomalies in sea surface temperatures showing the strong El Nino lying along the equator, the warmth of the north-east Pacific and western Atlantic and the colder than normal ocean temperatures of the northern North Atlantic

However, it does seem that this year the unusual warmth of the North East Pacific Ocean may have altered the position of these waves across North America and into the Atlantic sector, setting up the conditions for the devastating tornadoes in the US and for the southerly feed of moisture-laden air into

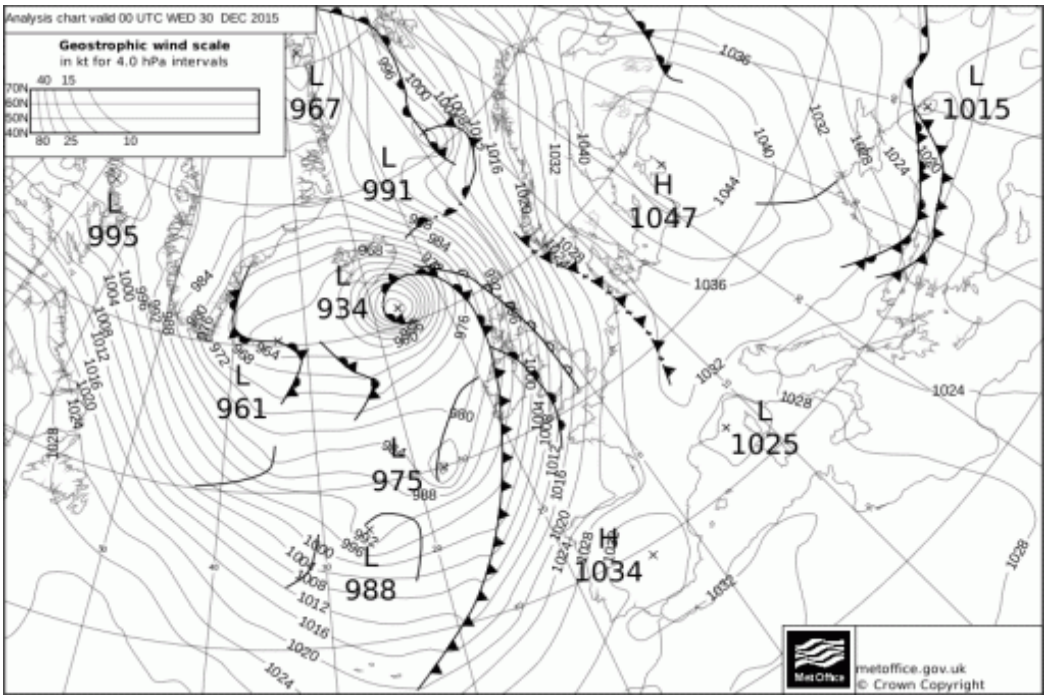
the UK.



Circulation anomalies in the middle troposphere for 1-30 and 24-30 December, showing a persistent pattern of troughs (blue/purple) and ridges (green/orange) across the US, North Atlantic and into Europe. The trough over the western US set up the conditions for tornadoes along the confluence of cold air from the north with very warm air from the Gulf (see elevated sea temperatures above). The southerly airstream from Spain to the North Pole is established by the gradient between the trough over the North Atlantic and the ridge over Europe.

Storm Desmond in early December was associated with a strong west-south-westerly flow around the ridge over the eastern seaboard of the US, reaching far back across the Atlantic, as far as the Caribbean. With ocean temperatures well above normal in the southern part of the North Atlantic (see above) – possibly due to the much weaker than normal hurricane season this year associated with the current El Nino – the air was primed with more moisture than normal. This river of atmospheric moisture fed the storms that formed on a stronger than normal jet stream, and as the air impinged on the mountains of Cumbria, large quantities of rainfall were released.

Later in the month the southerly flow intensified, with a high pressure system to the east of the UK over continental Europe providing a block to the normal passage of the westerly jet. With colder than usual ocean temperatures over the northern part of the North Atlantic (see above), a strong temperature gradient formed which acted to strengthen the jet and set up the conditions for the formation of rapidly deepening cyclones, such as Storm Frank. These cyclones drew in warm, moist air from far south leading again to heavy rainfall and further flooding on already saturated ground. And the southerly winds on the eastern flank of Storm Frank, and strengthened by the high pressure to the east, enabled extremely warm air to penetrate, temporarily, the deep Arctic leading to very high temperatures.



Surface pressure chart 0001 30 December 2015

The potential for December to be stormy and wet was picked up in the three-month outlook and is consistent with what we expect in early winter when there is a strong El Nino in place. However, early analysis suggests that the specific nature of this December's extreme weather might be linked to the detailed structure of this El Nino, to the warmth of the north-east Pacific Ocean and to their combined effects on the atmospheric circulation.

As for whether climate change has played a role, we know that the overall warming of the oceans increases the moisture content of the atmosphere by around 6% for every 1°C warming. This extra moisture provides additional energy to the developing weather system, enabling even more moisture to be drawn in to the system, so that the overall enhancement of rainfall when the moisture-laden air impinges on the mountains of Wales, northern England and Scotland may be even more significant. So from basic physical understanding of weather systems it is entirely plausible that climate change has exacerbated what has been a period of very wet and stormy weather arising from natural variability.

Date Created
December 2015